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Central Intelligence Agency

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DIRECTORATE OF INTELLIGENCE

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CHINA: FERTILIZERS FOR AGRICULTURE

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We believe China will have difficulty meeting the modest fertilizer production goals of the Sixth Five Year Plan. Since 1980, increases in fertilizer production have slowed sharply because of lower investment, changing agricultural institutions, and a restructuring of the fertilizer industry designed to increase efficiency. Plans for expansion of potassium and phosphate fertilizer production are, we believe, overly ambitious, and China will have to increase imports substantially to meet the levels we project will be necessary to achieve agricultural production targets. China will probably continue to reduce its dependence on Japan for nitrogen fertilizers and increase purchases of lower-priced Soviet Bloc and OPEC products, as well as phosphates and compound fertilizers from the United States and potassium from Canada. We estimate that 1985 purchases of fertilizers could cost more than $1.2 billion, about 4 percent of total planned 1985 imports.

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We expect China to increase outlays for new fertilizer capacity through mid-decade, but investment levels will not reach the peak levels of the mid-1970s. Most new projects will be for phosphates, potassium, and compound fertilizers. Energy efficiency and the availability of coal-based processes will be major considerations in technology selection. China probably will seek few whole plant imports, and those will probably be purchased from West German and Japanese chemical plant contractors. US firms will probably be involved in licensing technologies, designing plant layouts, and particularly in upgrading existing facilities.

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Production Trails Demand

Consumption of chemical fertilizers in China continues to outpace domestic production (see Table 1), despite heavy

This memorandum was prepared by [redacted] *the China Division of the Office of East Asian Analysis.*

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investment through the mid-1970s designed to overcome the problem. Between 1973 and 1982, China nearly tripled chemical fertilizer production. A large share of the increase can be attributed to the 1972-3 import of 13 large nitrogen fertilizer plants which began operations after 1976. [redacted] 25X1

Based on fertilizer consumption trends and planned increases in agricultural production through 1985, we expect consumption to increase at 4 to 6 percent per year, yet China's plans call for only 1 percent annual growth in production. China's actual fertilizer use (in kilograms applied per hectare) is still only about half the world average, leaving considerable room for continued consumption growth. [redacted] 25X1

Table 1. The Production-Consumption Gap, 1973-85* [redacted] 25X1
(thousand metric tons)

Year	Production	Consumption	Difference
1985 Scenario I**	13,400	18,049	4,649
1985 Scenario II**	13,400	17,046	3,646
1982	12,990	15,154	2,164
1981	12,390	14,536	2,146
1980	12,320	13,556	1,236
1979	10,653	11,495	842
1978	8,693	9,524	831
1977	7,238	7,581	343
1976	5,244	6,244	1,000
1975	5,247	5,889	642
1974	4,222	5,557	1,335
1973	4,592	5,598	1,006

* Data for 1973-81 from Zhang Qinhan and Zhai Xi, "The Production Consumption and Importation Statistical Figures of Chinese Chemical Fertilizers in Recent Ten Years." Both authors are officials of the Chemical Fertilizer Department, Ministry of Chemical Industry. Production data for 1982 is from State Statistical Bureau announcements; consumption for 1982 is estimated on the basis of available production and import data.
** Scenario I for 1985 assumes planned production levels and a 6 percent annual increase in consumption; Scenario II assumes planned production levels and a 4 percent annual increase in consumption.

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Investment Declining

Chinese government and press reports maintain that, because of the production-consumption gap, chemical fertilizer is a top-priority industry. Investment, however, has dropped sharply since 1977 (see Table 2). Investment had been high through the mid-1970s, when China added many domestic plants in addition to the imported facilities. We believe investment slumped thereafter for several reasons:

- Readjustment policies begun in 1979 forced the Ministry of Chemical Industry to reassess its expansion policies, close many small inefficient plants, and reconsider the availability of feedstocks for additional large plants;
- Beijing probably wanted to delay further major expansion of agricultural inputs until the effect of incentive-oriented agricultural reforms could be evaluated; and
- A worldwide abundance of fertilizers pushed international prices down and made imports more attractive than building new capacity.

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Table 2. Investment in Chemical Fertilizer and Pesticides*

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Year	Million Current Yuan	Share of Industrial Investment	Percent Change from Previous Year
1981	442	2.1	-50.4
1980	891	3.3	-27.8
1979	1,234	4.8	-17.7
1978	1,500	5.5	-21.3
1977	1,907	8.8	--

* Investment in pesticides amounted to 15 million yuan in 1981 and 61 million in 1980. We have insufficient data to separate fertilizer from the total investment figures in prior years.

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The Ministry of Chemical Industry recently announced resumption of work on three imported plants postponed by readjustment, and several additional projects are underway or planned (see section on imported plants, below). We believe that this signals an end to the hiatus in fertilizer industry development and that investment will increase slowly over the next few years.

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Energy's Role in Reshaping the Fertilizer Industry

China is trying to improve the industry's efficiency through energy conservation measures. Energy waste in the fertilizer industry already has led to closure of more than 600 small plants since 1980. The main reason for the efficiency drive was the rapid increase in the share of energy consumed by the fertilizer industry, largely caused by a proliferation of small, inefficient plants built in the mid-1970s by localities for self-sufficiency. Data is not available to calculate energy use for the whole fertilizer industry, but we estimate that about 3.4 percent of total primary energy production is used to manufacture ammonia and convert it into nitrogen fertilizer (see Table 3).

At any rate, Beijing clearly has been concerned about the industry's energy consumption levels. The energy efficiency drive has resulted in about a 10 percent efficiency improvement annually since 1976, primarily a result of the closure of so many small plants and the increased impact of energy-efficient imported plants. We do not expect efficiency improvements to continue at this rate. At 1985 planned output levels, the nitrogen fertilizer industry will still use an estimated 3.3 percent of primary energy production, or about 22.4 million metric tons of standard coal equivalent (sce), according to our estimates.

Table 3. China: Energy Consumption for Nitrogen Fertilizer Production

	Energy Consumption (million metric tons of sce*)	Share of National Energy Production (percent)	Energy Consumption Per Ton of Nitrogen (tons of sce)
1985**	22.79	3.3	2.16
1981	22.23	3.3	2.25
1980	23.05	3.6	2.31
1979	22.40	3.5	2.54
1978	22.18	3.4	2.90
1977	18.30	3.3	3.32
1976	14.07	2.8	3.68

* Standard coal equivalent
** Calculated from 1985 plan data

We do not believe that energy consumption levels have been or will be a limiting factor in fertilizer industry development, but Beijing has changed its long-run fertilizer development plan to consider more carefully energy factors. Shortages of natural gas in the late 1970s prevented some of the imported urea plants from operating at capacity, and inadequate natural gas delivery systems forced China to convert two plants -- at considerable

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expense -- to naphtha feedstocks. As a result, the Chinese no longer expect to develop a large nitrogen fertilizer sector based on natural gas. Coal now seems to be the favored energy source, with at least two large coal-fired plants under construction. These feedstock problems have caused short-run output losses, may have constrained the production targets for 1985, and will continue to affect long-term industry planning. [redacted] 25X1

Table 4. Estimated Energy Feedstocks for Nitrogen Fertilizer Production [redacted] 25X1

Year	Coal (million metric tons)		Electricity (billion kilowatt hours)		Natural Gas/Naphtha (billion cubic meters)
1981	23.2	(3.8)*	16.9	(5.4)	4.1
1980	24.4	(4.0)	17.7	(5.9)	3.9
1979	24.6	(3.9)	16.9	(6.0)	3.3
1978	25.7	(4.1)	17.0	(6.6)	2.5
1977	21.8	(3.9)	14.7	(6.5)	1.5
1976	18.3	(3.8)	13.3	(6.5)	0.2

* Share of national production of coal and electricity shown in parentheses. Calculations for natural gas and Naphtha is not feasible because of a lack of data on naphtha production and on the share represented by each fuel.

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Production Problems Complicate Planning

A pressing problem for the Ministry of Chemical Industry is product mix. Nitrogen fertilizer (N) dominates the industry, accounting for 80 percent of total production; phosphates (P) represent nearly all of the remainder; potassium (K) production is negligible (see Table 5). This product mix includes too little phosphate and potassium and the resulting imbalance reduces the effectiveness of fertilizer applications. In 1978, China's NPK application ratio was 1:0.32:0.02, far below the optimal ratio recommended by Western specialists of 1:0.50:0.33; this optimal ratio would require a 57 percent increase in the supply of phosphates, and a 16-fold increase in potassium. [redacted] 25X1
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At least some of the nutrient shortfall is offset by organic fertilizers, but Ministry officials have expressed considerable concern over the imbalance in product mix. The problem has been aggravated by the small plant closures in 1978-80. We estimate that these plants could have produced up to 1.5 million metric tons per year of nitrogen fertilizer and, more importantly, 1 million metric tons of phosphate fertilizer. [redacted] 25X1

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Table 5. PRC: Chemical Fertilizer Production [redacted] 25X1
(million metric tons of nutrients)

Year	Total	Increase Percent	Nitrogen	Phosphates	Potassium
1982	12.99	4.8	10.26	2.71	0.03
1981	12.39	0.0	9.86	2.51	0.02
1980	12.39	16.3	9.99	2.31	0.02
1979	10.65	22.6	8.82	1.82	0.02
1978	8.69	20.0	7.64	1.03	0.02
1977	7.24	38.2	5.51	1.71	0.02
1976	5.24	--	3.82	1.42	0.01

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Product quality has evoked concern as well. Although the closure of the small inefficient plants probably marginally increased overall quality, most Chinese fertilizers do not meet international standards. When available, Chinese consumers prefer imported to domestically produced fertilizers -- which sell at the same price -- because of the vast difference in quality. Chinese workers have tried to duplicate the quality of Japanese urea, but have not been able to do so, primarily because of outmoded equipment. In addition, the majority of Chinese nitrogen fertilizer is still ammonium bicarbonate, which is volatile and deteriorates rapidly between factory and field. Improvements in distribution would help by moving the product more quickly to consumers, but bagging facilities and transportation are inadequate and delays are the rule. We estimate that delivery time from port or plant to field averages five to six months. [redacted] 25X1

Imports: A Continuing Requirement

Despite increases in domestic production, China's dependence on imports will probably increase over the next several years. According to Ministry of Chemical Industry data, imports accounted for 15 percent of fertilizer supplies in 1981 (see Table 6). Imports as a share of supply dropped steadily through the 1970s because of increased production, relatively slower growth in consumption, and higher world fertilizer prices. Annual increases in consumption of 4 to 6 percent will necessitate growth in imports of 13 to 23 percent per year through 1985. Our low estimate of fertilizer import expenditures in 1985, $805 million, assumes 13 percent annual growth and stable prices. At 23 percent growth and with a revival of now-depressed prices, China's fertilizer imports could cost more than $1.2 billion, about 4 percent of total planned 1985 imports; this is about the same share of imports represented by fertilizers in 1979, and a little lower than the 1980-81 shares. [redacted] 25X1

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Table 6. The Role of Fertilizer Imports, 1972-82 25X1

Year	Production	Imports	Consumption	Imports Share of Consumption
	(thousand metric tons of nutrients)			(percent)
1985 (4%)*	13,400	3,646	17,046	21.4
1985 (6%)*	13,400	4,649	18,049	25.8
1982**	12,990	2,519	15,154	15.9
1981	12,390	2,290	14,536	15.0
1980	12,320	2,058	13,556	14.0
1979	10,653	1,748	11,495	14.1
1978	8,693	1,504	9,524	14.8
1977	7,528	1,322	7,581	15.0
1976	5,244	960	6,244	16.0
1975	5,247	1,037	5,889	17.9
1974	4,222	1,067	5,557	21.4
1973	4,592	1,306	5,598	24.3

* Projections for 1985, using the planned production level and 4 to 6 percent average annual growth estimates for consumption.
** Consumption data estimated based on production and prior year import data; import data equals consumption less production.

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Import composition and suppliers. Although China's fertilizer imports continue to be dominated by the Japanese, other countries, including the United States, will increase their market share over the next few years. Nitrogenous fertilizers -- particularly urea -- are the bulk of Chinese fertilizer imports (see Table 7). Japan supplies 30 to 40 percent of China's imports, and China accounts for 60 to 67 percent of Japan's total nitrogen fertilizer exports. Since 1980, cutbacks in Chinese purchases from Japan -- the result of higher prices, increased Chinese domestic capacity, and greater interest in compound fertilizers -- have hit Japanese industry particularly hard. Up to one-third of Japanese ammonia capacity may be shut down, primarily because of declining sales to China. East European, Soviet, and OPEC suppliers are also assuming larger shares of the Chinese market, primarily on the basis of lower prices. 25X1

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At present, the United States is the source of perhaps 80 percent of China's imports of manufactured phosphate fertilizers, primarily concentrated superphosphates. The United States is also China's largest supplier of compound fertilizers. China has been focusing on purchases of diammonium phosphate (DAP) which has high nitrogen and phosphate content. China has explored buying DAP but still obtains most from the United States. Morocco and Jordan supply most of China's phosphate rock imports. For potassium fertilizers, Canada is the dominant supplier. 25X1 25X1

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As the primary supplier, US producers should benefit from the increasing share of Chinese imports represented by phosphates and compound fertilizers. Since the mid-1970s, nitrogen has accounted for a rapidly decreasing share of China's fertilizer expenditures, with purchases of compound fertilizers rising sharply and of phosphates and potassium increasing more slowly. The total value of all fertilizer imports increased at an average annual rate of about 13 percent between 1975 and 1981, of which nitrogen increased 5 percent annually, phosphates 32 percent, and potassium and compound fertilizers both 65 percent. Although one industry journal claims that China is currently over-stocked with compound fertilizers, we do not expect purchases of compounds to diminish.

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Table 7. Nutrient Composition of Fertilizer Imports

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(percent share of expenditues on fertilizer imports)

Year	Nitrogen	Phosphates	Potassium	Compound
1981	61	10	11	18
1980	68	8	5	18
1979	83	7	6	4
1978	75	8	2	15
1977	84	7	1	8
1976	93	6	0	1
1975	93	4	1	2

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A More Astute Consumer. China is becoming a more sophisticated buyer in the international fertilizer markets. Because China is generally the world's largest fertilizer buyer, its actions can have an impact on world prices. On occasion, Beijing has entered world markets looking to make purchases, and the attendant publicity has driven prices up before a sale could be completed. In recent years, Beijing has diversified purchases to dampen effects on prices, signing smaller contracts with a large number of brokers and producers.

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Although continuing to purchase from traditional suppliers -- Japan, Canada, and the United States being dominant -- Sinochem, the Chinese chemical trade organization, has committed 40 percent of known year-to-date contracts to Saudi Arabia and Kuwait, and may make additional purchases from Middle Eastern suppliers.

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Imported Plants and Equipment. A major factor in the changed composition of fertilizer imports in the late 1970s was the initiation of operations at the 13 large ammonia-urea complexes purchased in 1972-73. We estimate that by 1980, these

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plants accounted for nearly one-fourth of China's nitrogen fertilizer production and about 80 percent of total urea output.

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The Chinese have constructed a duplicate of these complexes at a site near Shanghai. The copy took only slightly longer to build than the imported plants and has been at least partially operating for about four years. Apparently China has not yet been able to repeat the accomplishment, however, and has had to purchase two additional complexes from German and Japanese suppliers for completion in 1984-5.

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China has 11.8 billion tons of phosphorous ore reserves -- the fourth largest in the world after the United States, Soviet Union, and Morocco.

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impurities in Chinese phosphate rock limit the development of a large-scale phosphate fertilizer industry with current technologies. The China National Chemical Construction Corporation nonetheless tentatively plans to build trisodium phosphate and diammonium phosphate plants in Shanghai, probably using US technologies. Construction started early this year on China's first large compound fertilizer plant, which will produce 900,000 tons per year of nitrophosphate using West German and Japanese equipment. Three large phosphate mines planned for completion in 1985 would help provide feedstocks for these projects.

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An Irish firm is conducting feasibility studies for a potassium project in western Qinghai Province. China, with United Nations Development Program aid, plans a 1 million ton-per-year extraction facility at the site, which has reserves of about 100 million tons of potassium chloride. This is the only known large potassium project currently underway.

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US firms will probably participate in any expansion of China's fertilizer industry primarily by designing new facilities and licensing technologies, especially for ammonia and sulfuric acid processes used in urea and phosphate fertilizer plants. Japanese and European firms dominate the manufacture and assembly of chemical fertilizer plant equipment.

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China may seek Western help to upgrade existing ammonia plants. US and UK firms have developed methods by which existing plants can be renovated to produce better quality ammonia using 20 percent less energy. This type of plant improvement would be consistent with Beijing's modernization drive.

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Prospects for 1985

According to the Sixth Five Year Plan (1981-85), China intends to shore up the phosphate and potassium sectors and maintain very slow growth in nitrogen fertilizer production. New capacity additions by 1985 are to include 2.24 million tons of urea, 1.52 million tons of ammonia, and 46,000 tons of phosphates. 25X1

Table 8. Fertilizer Output Plans, 1985 25X1

	Planned Production (million metric tons of nutrient)	Increase over 1982 (Percent)
Total	13.4	3.1
Nitrogen	10.55	2.9
Phosphate	2.80	3.4
Potassium	0.05	92.3

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We do not expect the Chinese to meet these goals. Large-scale nitrogen fertilizer plants now under construction will probably not be completed on schedule. Local authorities will fight to keep their small plants operating and thereby undercut Ministry efforts to streamline the industry. As a result, total nitrogen fertilizer production may exceed the target in volume terms, but, because of the continued operation of small plants, Beijing's objectives for improvements in product quality and raw material consumption will not be accomplished. 25X1

Increases in phosphate production may be possible but we expect most of the planned increase to come from use of ground phosphate rock rather than manufactured fertilizers. We do not expect the Chinese will be able to achieve goals for potassium output. It is very unlikely that the Qinghai project could be productive by 1985. Smaller domestically developed projects could add some capacity, but not the planned volume. In addition, transportation bottlenecks could complicate the exploitation of remotely located phosphate and potassium projects. Even if expansion of phosphate and potassium production were to meet goals, the increase will not offset planned growth in nitrogen production, so an improved NPK ratio in fertilizer applications will depend on imports of phosphates and potassium -- assuming, of course, that all of the available nitrogen fertilizer will be used. 25X1

We therefore expect imports to continue at high levels. The extent of import expansion will depend in part on international price levels, availability of hard currency for payments, and transportation. Late last year, Beijing completed a 1500-ton-per-day bagging facility near Shanghai to take advantage of lower bulk prices (bagging adds up to $25 per ton) and to

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alleviate transportation congestion. Some urea imports will probably continue to shift from Japan to the Middle East, Eastern Europe, and the Soviet Union. Canada will remain the dominant supplier of potassium fertilizers, and the United States of phosphate and nitrogen/phosphate compounds. [redacted] 25X1

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